**Topics 04 – Bonding (SL/HL 1)**

**Topic 4: Bonding (12.5 hours)**   
  
**4.1 Ionic bonding - 2 hours**   
4.1.1 Describe the ionic bond as the electrostatic attraction between oppositely charged ions. (2)   
4.1.2 Describe how ions can be formed as a result of electron transfer. (2)   
4.1.3 Deduce which ions will be formed when elements in groups 1, 2 and 3 lose electrons. (3)   
4.1.4 Deduce which ions will be formed when elements in groups 5, 6 and 7 gain electrons. (3)   
4.1.5 State that transition elements can form more than one ion. (1)   
4.1.6 Predict whether a compound of two elements would be ionic from the position of the elements in the periodic table or from their electronegativity values. (3)   
4.1.7 State the formula of common polyatomic ions formed by nonmetals in periods 2 and 3. (1)   
4.1.8 Describe the lattice structure of ionic compounds. (2)   
**4.2 Covalent bonding - 6 hours**  
4.2.1 Describe the covalent bond as the electrostatic attraction between a pair of electrons and positively charged nuclei. (2)   
4.2.2 Describe how the covalent bond is formed as a result of electron sharing. (2)   
4.2.3 Deduce the Lewis (electron dot) structures of molecules and ions for up to four electron pairs on each atom. (3)   
4.2.4 State and explain the relationship between the number of bonds, bond length and bond strength. (3)   
4.2.5 Predict whether a compound of two elements would be covalent from the position of the elements in the periodic table or from their electronegativity values. (3)   
4.2.6 Predict the relative polarity of bonds from electronegativity values. (3)   
4.2.7 Predict the shape and bond angles for species with four, three and two negative charge centres on the central atom using the valence shell electron pair repulsion theory (VSEPR). (3)   
4.2.8 Predict whether or not a molecule is polar from its molecular shape and bond polarities. (3)   
4.2.9 Describe and compare the structure and bonding in the three allotropes of carbon (diamond, graphite and C60 fullerene). (3)   
4.2.10 Describe the structure of and bonding in silicon and silicon dioxide. (2)   
**4.3 Intermolecular forces - 2 hours**  
4.3.1 Describe the types of intermolecular forces (attractions between molecules that have temporary dipoles, permanent dipoles or hydrogen bonding) and explain how they arise from the structural features of molecules. (3)   
4.3.2 Describe and explain how intermolecular forces affect the boiling points of substances. (3)   
**4.4 Metallic bonding - 0.5 hour**   
4.4.1 Describe the metallic bond as the electrostatic attraction between a lattice of positive ions and delocalized electrons. (2)   
4.4.2 Explain the electrical conductivity and malleability of metals. (3)   
**4.5 Physical properties - 2 hours**   
4.5.1 Compare and explain the properties of substances resulting from different types of bonding. (3)   
  
**Topic 14: Bonding (5 hours)**   
  
**14.1 Shapes of molecules and ions - 1 hour**   
14.1.1 Predict the shape and bond angles for species with five and six negative charge centres using the VSEPR theory. (3)   
**14.2 Hybridization - 2 hours**   
14.2.1 Describe pi and sigma bonds. (2)   
14.2.2 Explain hybridization in terms of the mixing of atomic orbitals to form new orbitals for bonding. (3)   
14.2.3 Identify and explain the relationships between Lewis structures, molecular shapes and types of hybridization (sp, sp2 and sp3). (3)   
**14.3 Delocalization of electrons - 2 hours**   
14.3.1 Describe the delocalization of pi electrons and explain how this can account for the structures of some species. (3)